

Mitigation Strategies for Acute Radiation Exposure during Space flight

Douglas R. Hamilton MD, PhD¹

Slava Epelman PhD²

¹Wyle Laboratories Houston, TX, USA.

²University of Calgary Medical School, Calgary, AB, Canada.

While there are many potential risks in a Moon or Mars mission, one of the most important and unpredictable is that of crew radiation exposure. The two forms of radiation that impact a mission far from the protective environment of low-earth orbit, are solar particle events (SPE) and galactic cosmic radiation (GCR). The effects of GCR occur as a long-term cumulative dose that results increased longer-term medical risks such as malignancy and neurological degeneration. Unfortunately, relatively little has been published on the medical management of an acute SPE that could potentially endanger the mission and harm the crew.

Reanalysis of the largest SPE in August 1972 revealed that the dose rate was significantly higher than previously stated in the literature. The peak dose rate was 9 cGy h^{-1} which exceeds the low-dose-rate criteria for 25 hrs (National Council on Radiation Protection) and 16 hrs (United Nations Scientific Committee on the Effects of Atomic Radiation). The bone marrow dose accumulated was 0.8 Gy, which exceeded the 25 and 16 hour criteria and would pose a serious medical risk. Current spacesuits would not provide shielding from the damaging effects for an SPE as large as the 1972 event, as increased shielding from $1-5 \text{ gm/cm}^2$ would do little to shield the bone marrow from exposure. Medical management options for an acute radiation event are discussed based on recommendations from the Department of Homeland Security, Centers for Disease Control and evidence-based scientific literature. The discussion will also consider how to define acute exposure radiation safety limits with respect to exploration-class missions, and to

determine the level of care necessary for a crew that may be exposed to an SPE similar to August 1972.

Learning Objectives

- 1.) The audience will understand the difference between acute and chronic effects of space radiation.
- 2.) The audience will understand the challenges of providing medical treatment for bone marrow, gastro-intestinal and neurological radiation syndromes.
- 3.) The audience will understand the need to define the level of care required to support a crew member exposed to an SPE and relationship of this to various vehicle and mission designs.